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Writing Across the Curriculum: Designing Science Lessons Using the Theory of Multiple Intelligences to Promote Literacy

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As science teacher educators, whose task is to facilitate learning for teachers of science, we impress upon our pre-service teachers to engage their students in writing activities to promote literacy in science. One of the issues that our teachers frequently express in class is that students don't like to read their textbooks or engage in traditional writing exercises. As we work with these pre-service teachers we assist them with developing a repertoire of strategies that can be used to engage students in reading and writing as they learn science.

One way to actively engage students in reading and writing is to use Howard Gardner's Theory of Multiple Intelligences. Dr. Howard Gardner, professor of education, at Harvard University, developed the Theory of Multiple Intelligences (Gardner, 1983). Dr. Gardner proposes eight different intelligences to account for a broad range of human potential in children and adults. These intelligences are verbal/linguistic, musical/rhythmic, bodily/kinesthetic, visual/spatial, interpersonal, intrapersonal, logical/mathematical, naturalist, and existential.

How We Promote Science Literacy through Writing

Strategies that we presented to these pre-service teachers infused six of Gardner's intelligences: verbal/linguistic, musical/rhythmic, bodily/kinesthetic, interpersonal, intrapersonal, and logical/mathematical. The strategies used were trade book reviews, poetry, reflection essays, journaling, analytical critiquing, and technical laboratory reporting. For each strategy there is a rubric for assessment to provide feedback to the students about their writing skills and their content knowledge.

Trade Book Reviews

The focus of the curriculum for most middle schools is on literacy; therefore, pre-service teachers must be equipped to adopt reading and writing lessons to include science topics and hands-on activities so that students are experiencing science daily. We recommend that teachers use the Theory of Multiple Intelligences to design lesson plans as well as the 5E Instructional Model (Trowbridge& Bybee, 1996) for inquiry-based instruction. There are five steps in the 5 E model: engaging, exploring, explaining, expanding, and evaluating. This model is used to design challenging lessons, and when it is coupled with Gardner's theory, teachers develop lesson plans that meet the needs of diverse student populations.

There is a fine array of children's literature available today that teachers can use to introduce their students to the world in which they live and, concomitantly, to teach reading and writing skills in a meaningful context (Bowers, 2000). The vicarious experiences children have through excellent literature not only can be used to teach reading and writing skills in context, but can also be used to help students see themselves in what they read, which is very motivating.

As our example, we started with the trade book, *Everybody Is Somebody's Lunch* by Cherie Mason (1998). Using the 5 E model, the pre-

service teachers were engaged by asking: What does the title of the book imply (verbal/linguistic)? Many of them gave the following responses before reading the book: "People eating other people", "People are dependent on other people", "Bite me and I'll bite you back", "The food chain", and "This is a dog eat dog world". Few of the students associated the title with a food chain, which is the direction that we would like for the lesson to move. After these responses, the author read the book orally (verbal/linguistic) to the students and then gave them an opportunity to respond again to the question. They immediately associated the title with predator/prey relationships and the food web.

It was at this time that we moved to the second E, which is exploring. Pre-service teachers were asked to work in small groups (interpersonal) and develop a plan for designing a food web. They were then given the opportunity to construct their food webs using resources in the science laboratory (bodily/kinesthetic). After the construction of the food webs, the pre-service teachers were asked to give a two minute presentation about why they had selected their particular model of the food web and to explain the interdependent relations of the web. The lesson then moved to the next E, explaining.

We discussed a salt-water marsh ecosystem and the various forms of life that are found there, in a large group setting with the students (verbal/linguistic). Interdependent relationships of organisms within the ecosystem were identified and discussed. Then the activity moved to the E of expansion where the pre-service teachers were asked to construct a salt water marsh using food cards (index cards with different organisms), yarn, and tape (bodily/kinesthetic). Students worked in small groups (interpersonal) to construct the salt-water marsh and compared this model with their previous model. As a means of evaluation, pre-service teachers were asked to write a book review (intrapersonal). All book reviews were to include operational definitions or terms specific to the book, a summary of the book, an explanation of the intended audience, the major themes with supporting details, the manner in which the book was organized, linkage to issues discussed in class, conclusions made by the author, an artistic illustration of the book (mini bulletin board), their reaction to the book and whether they would recommend it to others. Pre-service teachers were to present the reviews to the class and then do a peer assessment of each other using the Book Review Rubric (Appendix one).

Poetry

Our pre-service teachers were usually placed in urban schools where their students have a fondness for hip-hop music. At this point we asked the students individually (intrapersonal) to write a poem or song about the concept, ecosystems, (verbal/linguistic), set it to a beat (musical/rhythmic) and perform it for the larger group as a song and/or dance (bodily kinesthetic). The rubric in Appendix Two is used to assess the poem, song, and presentation.

Reflective Essays

Pre-service teachers were asked to write a reflective five-paragraph essay regarding the unit on the ecosystem. They were to use the 5-5-5-5-5 method of writing which is a means of teaching middle level students how to write the five-paragraph essay. In the first paragraph they are to write 5 sentences and one of the sentences must be the thesis sentence in which they identify three subtopics, which are to be used as the glue for organizing the essay. The second through fourth paragraphs restates one of the subtopics and contain 5 sentences each. The five sentences contain details, examples, and explanations of the subtopics. The fifth and final paragraph is a summary in which the thesis sentence is restated and summarizes the three subtopics and also contains 5 sentences. Reflective essays are evaluated using the Reflective Essay Rubric (Appendix Three)

Research and Technical Writing

Analytical Critiques

Article and journal reviews are critical and dynamic approaches to literacy because they allow

individuals to reconfigure text to fulfill specific greater control of both the content and the overall processes of reading and writing. Pre-service teachers are asked to read and critique two scientific articles. For middle grade students, articles from CHEM Matters, Discover, Science, Weekly Reader: Current Science or other journals can be assigned to read prior to beginning an inquiry project which requires technical writing. The copyright for the articles should be within the last five years.

The critique is divided into three sections: 1) summary, 2) vocabulary, and 3) reaction. In the summary, students were asked to review the author's purpose, hypothesis, methods of collecting data, data analysis and findings. The vocabulary section contains definitions that are specific to the article, and that are new to the student. Students are to give their opinion as to whether or not the author achieved his/her purpose in the reaction section. Also they are to identify three reasons that would cause them to question the validity of the research, identify the statistics used and if they were used appropriately to support the findings. Recommendations to improve as well as expand the article are included. (Article/Journal Critique Rubric Appendix Four)

Pre-service teachers are required to do lab experiments through inquiry projects. While in their practicum classrooms their middle grade students needs or to explore areas of interest, giving them also engage in these types of experiences. Each laboratory experience must be written as a technical report that includes technical writing guidelines. For example, a laboratory experiment would be performed on the "Determination of the Physical and Chemical Properties of a Model of a Saltwater Marsh', and students would be required to write a technical report of the laboratory experiment. After performing the laboratory experiment, each student is required to submit a technical report in a Power Point format that includes the items in the rubric for Laboratory Technical Report (Appendix Five).

These strategies were used with middle grade students in an effort to enrich their reading and writing skills. Four pre-service teachers used these strategies in their field practica experience with eighth grade students. They used technical laboratory reports, reflective essays, trade-book reviews, analytical journal critiques, and poems songs. After the implementation of these strategies with the eighth grade students, a survey (Science Writing Questionnaire Appendix Six) was administered to the students to determine their attitudes toward the various instructional strategies used to promote science literacy, specifically through science reading and writing. Table 1 is the results of the survey indicating students' attitudes toward writing in science.

Table 1
Attitude Toward Reading and Writing in Science

	# Disagree	# Agree	% Agree
Enjoy Writing Lab Reports	34	56	62.0%
Like reading trade books	49	41	45.6%
Like to write in Journals	37	37	50.0%
Understand science process by writing lab reports	28	62	68.9%
Understand science vocabulary better	49	38	43.6%
Writing in science helps writing in other classes	49	31	38.7%

Students' engagement with science on a regular basis is important for retention of science concepts and principles. Reading and writing about science helps students maintain connections to science in their everyday lives. Table 2 indicates that these students are moderately engaged with science on a weekly basis.

The question from the survey which asked "which literacy tool do you prefer for science?" gave the authors insight about students' preferences to these instructional strategies. Thirty eight percent preferred writing technical lab reports; thirty six percent trade-book review summaries; nineteen percent reflective essays; five percent preferred poetry and only two percent, journal article critiques. Other information generated from the survey indicated that students:

- understand science process better by writing technical lab reports.
- think about science at least once per week, and write about science at least twice a week.
- critique or analyze science articles at least once a year.
- believe writing in English class is more important than writing in science class.

These results are useful in providing teachers with the students' perspective of these instructional strategies and supply them with data to support the need to expose students to these strategies in an effort to effectively teach science and literacy.

All of the students in the classes for the field practicum of the pre-service teachers scored Meets Expectations or Exceeds Expectations on the Georgia Eighth Grade Writing Test. These results were statistically significant ($p < .05$) when compared with the previous years' classes. Using these types of alternative strategies is an effort to include all students' learning styles and intelligences and as a result improve their understanding of science concepts while having fun (Manley & Flournoy, 2005).

Table 2
Engagement with Science Writing and Reading

	# Disagree	# Agree	% Agree
Think about science at least 1/week	43	45	51%
Have to write about science at least 2/week	32	58	64.4%
Have science magazines or storybooks at	43	38	47%
Critique science materials at least 1/year	27	60	69%

Table 3
Writing Across the Curriculum

	# Disagree	# Agree	% Agree
Writing in English class is more important than writing in a science class	40	50	55.5%
Writing in science should be graded for grammar and sentence structure	55	35	38.9%
Writing in science helps me write better in other courses	49	31	38.7%

References

Bowers, P. (2000). Reading and writing in the science classroom professional development section of Houghton Mifflin's Science Discovery Works.

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. New York: Basic.

Manley, O.I. & Flournoy, B. (2005). One strategy does not work for all: Teaching diverse student populations. *The Georgia Science Teacher*. Douglasville, GA: Georgia Science Teachers Association.

Mason, C. (1998). *Everybody is somebody's lunch*. Gardiner, ME: Tilsbury House Publisher.

Trowbridge, L.W., & Bybee, R.W. (1996). *Teaching secondary school science*. Upper Saddle River, NJ: Merrill-Prentice Hall.

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Appendix One

Book Review Rubric

Descriptor	**Exceeds Expectations (10-9)**	**Meets Expectations (8-7)**	**Needs Improving (6-5)**
Oral Presentation	Clearly presented and well summarized	Stated well but summary was lacking details	Poorly stated and summary lacking details
Themes	Clearly identified and many supporting details	Identified and some supporting details	Poorly identified and lacking supporting details
Organization of the Book	Well organized and sequence identified	Organized but sequence not identified	No organization
Linkage to class topics	Comprehensively understood and linked to all topics	Well thought out and linked to some topics	Irrational thinking and not linked to any topics
Recommendations	A minimum of five with specific details	A minimum of three with details	Less than three with no details
Referral to other readers	Referral with many reasons given	Referral with few reasons given	Referral with no reasons given
Language	No grammatical errors	Few grammatical errors	Many grammatical errors
Knowledge of Science	Excellent documentation	Good documentation	No documentation
Appearance of written report (Pre-service teachers do not rate each other in this area)	Typed and followed APA Guidelines	Typed and followed some APA Guidelines	Not typed and did not follow APA Guidelines
Intended audience	Identifies more than two groups	Identifies one group	Does not identify a group
Artistic Illustration	Creative, substantial scientific information, theme well developed, and aesthetically appealing	Some creativity, some scientific information, theme developed and neat in appearance	Lacks creativity, no scientific information, theme not developed and appearance needs improvement

Appendix Two

Poem/Song Rubric

Descriptor	**Exceeds Expectations (10-9 points)**	**Meets Expectations (8-7 points)**	**Needs Improving (6-5 points)**
Accuracy of Information	Information is accurate and contains many details for the selected topic.	Information is accurate and contains some details for the selected topic.	Information is inaccurate and details are few.
Beat	Beat contributes to the message of the poem and is very suitable for the syntax of the poem.	Beat contributes to the message of the poem is somewhat suitable for the syntax of the poem.	Beat is inappropriate and does not contribute to the syntax of the poem.
Adherence to syntax of type of poem	Metre and rhythm are very suitable for the type of poem.	Metre and rhythm are somewhat suitable for the type of poem.	Metre and rhythm are not suitable for the type of poem.
Presentation	Clearly presented and involved the total group	Presented but was somewhat ambiguous and involved most of the group	Presented but was ambiguous and did not involve the group
Language /Grammar Usage	No grammatical errors, no sarcasm, and no profanity	Some grammatical errors, no sarcasm, no put downs, and no profanity	Many grammatical errors, sarcasm, put downs, and profanity
Rhythmic /Movement Dance	Rhythm and movement contribute significantly to the message of the poem.	Rhythm and movement contribute somewhat to the message of the poem.	Rhythm and movement do not contribute to the message of the poem.

Appendix Three

Reflective Essay Rubric

Descriptor	**Exceeds Expectations**	**Meets Expectations**	**Needs Improving**
Thesis Statement and Introductory Paragraph with 5 Sentences (Maximum 15 Points)	Thesis statement identifies three elements that can be supported in the body of the essay. (14-15 points)	Thesis statement identifies two elements that can be supported in the body of the essay. (11-13 points)	Thesis statement identifies at least one element that can be supported in the body of the essay. (≤10 points)
Three Supporting Paragraphs Linked to Subtopics and Contain 5 Sentences (Maximum Points 30)	Every paragraph (3 paragraphs) contains a topic sentence that supports the thesis sentence. (27-30 points)	Most paragraphs (2 paragraphs) contain a topic sentence that supports the thesis sentence. (22-26 points)	Few paragraphs (1 paragraph) contain a topic sentence that supports the thesis sentence. (≤ 21 points)
Supporting Details and Examples (Maximum Points 15)	Gives three or more examples and ideas are very well developed. (14-15 points)	Gives two or more examples and ideas are somewhat developed. (11-13 points)	Poor examples and ideas are poorly developed (≤ 10 points)
Mechanics – Spelling, Punctuation, Grammar, etc. (Maximum Points 20)	Few grammatical errors and excellent word usage (18-20 points)	Some grammatical errors and good word usage (17-14 points)	Many grammatical errors and poor word usage (≤13 points)
Conclusion Restates Thesis and Has 5 Sentences (Maximum Points 10)	Well organized around thesis sentence; very coherent (9-10 points)	Organized around thesis, somewhat coherent (7-8 points)	Poorly organized and lacks coherency (≤ 6 points)
Cohesiveness (Maximum Points 10)	Focused and very cohesive (9-10 points)	Somewhat focused and somewhat cohesive (7-8 points)	Not focused and lacks cohesiveness (≤ 6 points)
Total Points			

Appendix Four

Article/Journal Critique Rubric

Descriptor	**Exceeds Expectations (9-10)**	**Meets Expectations (8-7)**	**Needs Improving (6-5)**	**Comments**
Purpose	All variables are included comprehensively.	All variables are included.	All variables are not included.	
Hypothesis	Includes variables and is written in correct format.	Includes variables but is written inaccurately.	Does not include variables.	
Methodology	Comprehensively includes methodology components.	Includes most of the methodology.	Does not include important components of the methodology.	
Data Analysis	Indicates all analysis mechanisms	Indicates some analysis mechanisms	Indicates few to no analysis mechanisms	
Operational Definitions	All selected terms are operationally defined.	Most terms are operationally defined.	Some terms are operationally defined.	
Target Audience	Identifies and justifies selection of targeted audience	Identifies some possible targeted audiences	Identifies only one target audience	
Validity of the Research	Makes a judgment substantiated by evidence in the article	Makes a judgment based only on opinion	Does not make a judgment	
Use of Statistics (middle grades students may not be able to interpret statistics, however, they will be exposed to the use of statistics)	Identifies all types of statistics used with justification	Identifies most of the statistics used	Does not identify statistics used	
Validity of Conclusions	Makes a judgment substantiated by evidence in the article	Makes a judgment based on opinion	Does not make a judgment	
Recommendations	Recommendations are aligned with current research implemented in article	Recommendations are made but not well aligned with research implemented	No recommendations made	

Appendix Five

Laboratory Technical Report Rubric

Descriptor	**2-4 points**	**5-7 points**	**8 -10 points**	**Your Score**
Title	No title indicated	Inappropriate title	Inclusive of variables	
Purpose	No intended purpose	Purpose is limited	Stated Comprehensively	
Materials	No list indicated	Limited listing	All essential materials listed	
Experimental Procedures	Limited in scope	Exists but not stated in sequence	Comprehensively and concisely written in past tense and third person	
Data and Results	Graphs/tables are appropriate	Graphs/tables are appropriately labeled. Addresses some of the procedures	Graphs/tables are appropriate Addresses all of the procedures Explanation of Results	
Conclusions and Questions	Conclusions stated	States and defends conclusions, numerical reliability indicated	Defends conclusions and makes comparison with literature, numerical reliability, statements of systematic error	
References	Lacks sufficient sources and did not use referencing guidelines	Sufficient sources and adequate use of referencing guidelines	Exceptional sources and exceptional use of referencing guidelines	

Comments: Total Score: _____

Appendix Six

SCIENCE WRITING QUESTIONNAIRE FOR PRE-COLLEGE STUDENTS

SCHOOL NAME_____
GRADE THAT YOU ARE CURRENTLY IN_____
NAME OF THIS COURSE_____

DIRECTIONS: Completely darken the circle that best represents your thoughts about the statement at the left.
SD Strongly Disagree **D** Disagree **A** Agree **SA** Strongly Agree

INDICATION	**SD**	**D**	**A**	**SA**
Science requires knowing how to write.	○	○	○	○
I enjoy writing science lab reports.	○	○	○	○
Writing in an English class is more important than writing in a science class.	○	○	○	○
I expect my writing in science class to be graded for grammar and sentence structure.	○	○	○	○
I like to read trade books (biographies, autobiographies or stories) or literature about science.	○	○	○	○
I like to write down my ideas about science phenomena.	○	○	○	○
I think about science at least three times a week.	○	○	○	○
I write about something in science at least once a week.	○	○	○	○
I have science magazines or storybooks at home.	○	○	○	○
I analyze or critique science materials at least once during a school year.	○	○	○	○
I understand the scientific process better by writing lab reports.	○	○	○	○

I understand science vocabulary better by science writing assignments.	○	○	○	○
Writing in science helps me write better in my other classes/courses.	○	○	○	○

My favorite type of writing is :

- Lab Reports ○
- Journal Critiques ○
- Reflective Essays ○
- Trade book Reviews ○
- Poems/Songs ○